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The impacts of sustainability, extended producer responsibility and the circular economy on product pricing models

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Abstract
This paper examines product pricing in relation to Sustainability, Extended Producer Responsibility and the Circular Economy. Traditional linear economic systems focus on the use of mass production techniques to achieve the most competitively priced products on the marketplace. This in turn requires a large volume of resources to be consumed. The linear economic system is based on a closed loop system, where resources are used in product manufacture, and then used consumed by end user(s), to finally becoming waste products. Increasing consumption of natural resources, led to the evolution of (1) sustainability measures aimed at ensuring producers utilized more sustainable resources; (2) extended producer responsibility (EPR) schemes which placed burdens on producers to bear an economic cost for recovery and recycling activities for products they manufactured, and; (3) the circular economy, which sees producers encouraged to design products which use resources which are capable of being used by the r-imperatives. The results show implementing sustainability, EPR and the circular economy measures do impact costs and product prices.

Keywords: product pricing model, extended producer responsibility, circular economy, sustainability, business strategy

1. Introduction
A supply chain can be considered a collection of actors providing goods and services which flow from a point of origin to an end consumer. This flow of goods and services can entail multiple actors utilizing raw materials to produce products, which may potentially be consumed by other manufacturers to produce different products (Skinner, 1978; Porter, 1980; Johnson and Scholes, 1988) [35, 31, 22]. The traditional linear economic model is based on a closed loop manufacturing system where products are: (1) mass produced at the lowest possible costs; (2) waste production materials are not recycled; (3) products have a defined lifespan; (4) at the end of life (EOL) a product is disposed of with minimal recycling taking place (Gale, 1960; The Government of Netherlands, 2019) [18, 37]. [Fig. 1] presents a high-level view of the model:

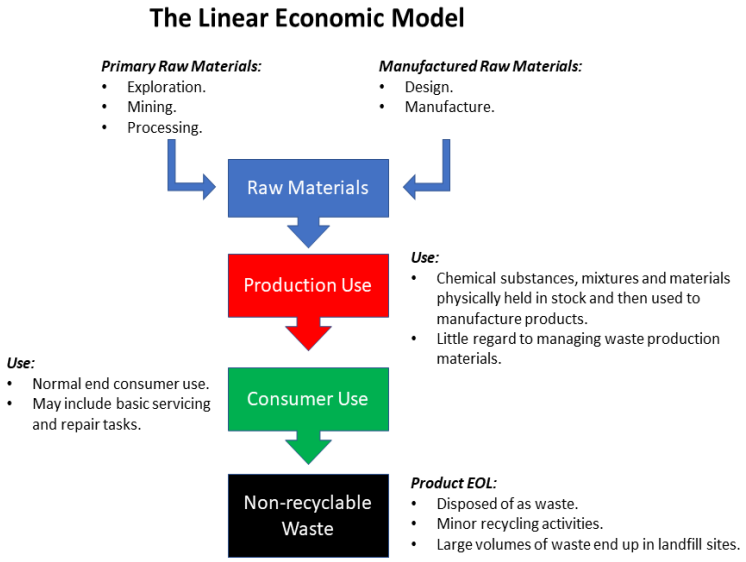

Fig 1: The Reuse (Sustainability) Economic Model [Based on: The Government of Netherlands, 2019] [37]

Product pricing models depend on: (1) the level of product maturity (introduction, growth, maturity and decline); (2) the level of competing products; (3) the price of competing products; (4) supplier power; (5) buyer power; (6) market barriers; (7) threat of new entrants entering the marketplace (Skinner, 1978; Porter, 1980; Johnson and Scholes, 1988; Henderson, 1989) [35, 31, 22]. Increasing mass production led to an increasing over consumption and rapid depletion of

natural resources. The Brundtland report (WCED, 1987) highlighted the need for: (1) sustainable development; (2) environmental protection; (3) economic growth, and; (4) social equity. Increasing societal advances have resulted in the mass mobility of goods, services, commodities, information people and communications across national frontiers (Prahalad and Hamel, 1990; Hopper, Lassoud, Soobaroyen, 2017) [32, 21]. Products today can be purchased online from anywhere in the world, this has initiated a proliferation of cheaper products disrupting the traditional supply and demand pricing model. Sustainability, EPR and the circular economy have gained prominence as a resulting of increasing awareness of resource depletion of natural resources. The movement towards sustainability, EPR and the circular economic model requires revalidation of the existing product pricing models. This paper attempts to examine: (1) key concepts relating to sustainability, EPR, circular economy, and; (2) assess the potential impacts to product pricing models.

2. Materials and Methods

The research undertaken consisted of: (1) searching for articles based using 'sustainability', 'EPR', 'circular economy' and 'product pricing' as search terms, appearing within the title of an article, and; (2) reviewing published website, journals and books. The literature review is based on the down selected articles and cross-referenced books.

3. Results

3.1 Sustainability

Following the publication of the Brundtland report (WCED, 1987), increasing pressures from Non-Governmental Organizations (NGOs), political parties and media led to a wider societal awareness of environmental issues, leading to pressures on manufacturers to make reforms. Sustainability covers: (1) establishment of social, economic and environmental targets for manufacturers; (2) utilization of non-scarce raw materials, from initial design, manufacture and maintenance of products; (3) ensuring products are designed to last much longer lifespans; (4) reducing the amounts of materials which end up in landfill sites; (5) ensuring the choice of raw materials allows for easier recycling activities; (6) resultant sustainable products are deemed to require less repair and servicing, ultimately eliminating the need for replacement products (WCED, 1987; Carter and Rodgers, 2008; Tate, Ellram, Dooley, 2012; Kanchanapibul, et. al, 2014; EC, 2015; Joshi and Rahman, 2015; Kumar and Rahman, 2015; Kolotzek, *et al*., 2018) [36, 24, 23, 26]. [Fig. 2] presents a high-level view of the model:

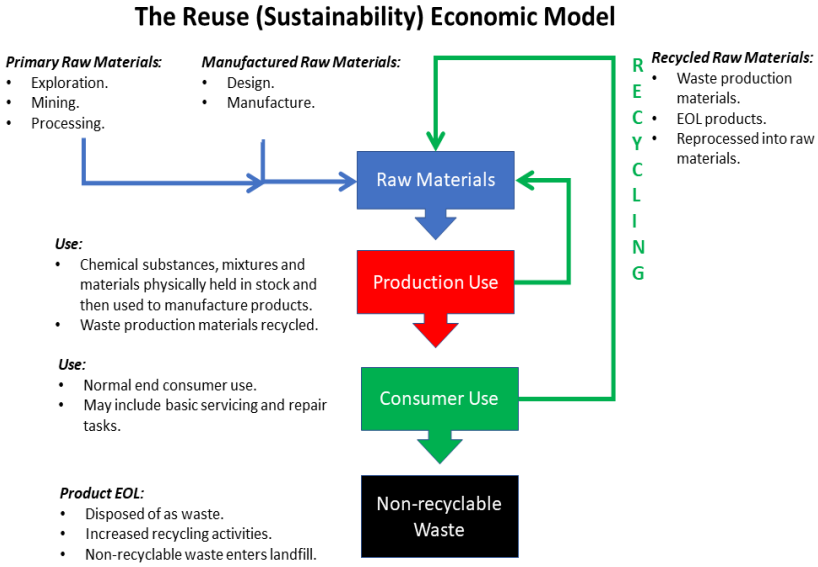

Fig 2: The Reuse (Sustainability) Economic Model [Based on: The Government of Netherlands, 2019] [37]

Consumers can make informed purchasing decisions switching towards those product brands which impact the environment the least (Kanchanapibul, et. al, 2014; Joshi and Rahman, 2015; Kumar and Rahman, 2015) [24, 23, 26]. The bottom line for manufacturers is that sales revenue can decline if there are societal pressures towards the use of more sustainable products.

3.2 United Nations Sustainable Development Goals

The UN Sustainable Development Goals (SDGs) set out 17 high-level goals with a further 169 lower-level targets to enable environmental, economic and social goals to be achieved by 2030 (UN SDG, 2019) [33]. The UN SDGs are implemented as a mixture of international and regional measures. The UN SDGs are non-mandatory targets for industry to achieve, however industry adheres to the UN SDG's, to prevent adverse publicity and damage to brand reputation. UN SDG goals 8, 9 12 refer to sustainable innovation, design and production. There are several other SDGs which can be utilized to aid industry to potentially increase competitive advantages. The potential business case because of implementing the UN SDGs was estimated be at US$12 trillion by 2030 (PwC, 2015; Businesscommission.org., 2017) [33].

3.3 Extended Producer Responsibility (EPR)

EPR schemes place a burden on producers, to become involved in the End of Life (EOL) product collection and processing (OECD, 2001; Thun and Müller, 2010; Agrawal, 2014; OECD, 2016; OECD, 2019). Increasing reliance on landfill sites for waste processing, led to several European Union (EU) regulations aimed at reducing the cycle of waste to landfill. Under EU law, there are four specific directives which define EPR activities for manufacturers (EC

Packaging and Packaging Waste Directive, 1994; EC End of Life Vehicles, 2000; EU Waste Framework Directive, 2008; EU WEEE, 2012) [9, 8, 17, 16], examples of actions for manufacturers to undertake, include: (1) manufacturer acceptance of packaging waste; (2) manufacturer acceptance of returned products; (3) manufacturer acceptance of waste after a product become EOL; (4) manufacturer acceptance of waste management; (5) manufacturer acceptance of any financial costs associated with waste management. Manufacturers can choose to collect and recycle EOL products individually or via a local authority or private scheme (often managed by trade associations supporting an industry sector). Manufacturers are expected to pay fees based on: (1) the number of EU countries a product is imported into (if manufactured externally to the EU) / or manufactured within the EU; (2) the number of products being placed onto the marketplace. The fee is intended to cover the costs for recycling and recovery of both packaging materials and those contained within the product(s). EPR schemes make manufacturers consider additional cost impacts from placing products onto the marketplace. EPR should result in products being designed for more simpler recycling and repurposing activities.

The CE model proposes the use of open-loop manufacturing systems, where the fundamental aim is to keep on using EOL products, recycling and recovering materials, and only sending materials into landfill sites as a last resort. [Fig.3] presents a high-level view of CE. The fundamental aims of the circular economy are: (1) design out waste from a products lifecycle; (2) use of the R-imperatives: (*(a) reduce consumer demand for new products which use scarce materials, (b) increase consumer product resale and reuse of EOL products; (c) repair EOL products for continued usage; (d) manufacturers refurbish EOL products to be placed back onto the marketplace; (e) apply materials and update components to remanufacture EOL products to new standards; (f) take EOL products, disassemble repurpose products for new uses; (g) apply recycling activities to EOL products to secondary raw materials; (h) the only waste that cannot be recycled shall end up in landfill sites*); (3) over time products will become designed to last longer, with less need for disposal; (4) products will contain mainly materials that exhibit highly recyclable content; (5) recycled content will generate secondary raw materials which can be reused in the production system (EC, 2015; Zeng, *et al*., 2017; Reike, *et al*., 2018; Ellen MacArthur Foundation, 2019) [9, 42, 34, 7]

3.4 Circular Economy (CE)

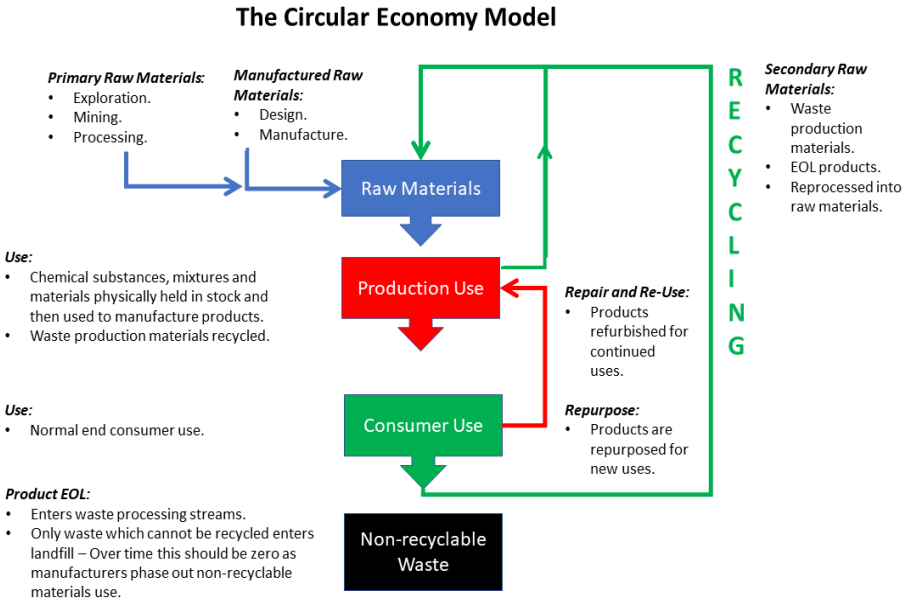

Fig 3: The Reuse (Sustainability) Economic Model [Based on: The Government of Netherlands, 2019] [37]

The EU set out two projects: (1) In 2010, the EU set out a roadmap agenda for growth and sustainability, known as the Europe 2020 project. The Europe 2020 project contained national and regional *targets ((a) employment; (b) research & development; (c) climate change and energy; (d) education, and; (e) poverty and social exclusion)*. The Europe 2020 project has been a success in many areas while lacking progress in (a), (b) and (e) (Eurostat, 2018; EC, 2019a; EC, 2019b; EC, 2019c); (2) In 2014, the EU set out a roadmap for 2030 which included a greater transition towards the circular economy focusing (*(a) reducing climate change; (b) increasing the use of renewables; (c) increasing energy efficiency and energy*) (EC, 2014). Estimated figures for annual material savings because of the circular economy are projected at: (1) US$700 Million within the consumer goods sector; (2) US$550 Billion reduction in health care costs from the food sector; (3) €3,000 disposable income increases for EU households (Ellen MacArthur Foundation, 2019) [7].

3.5 Product Lifecycle and Market Growth

The level of product lifecycle maturity and the market position of a product play a role in determining potential product pricing strategies. A combination of the Boston Growth-share matrix and the product lifecycle maturity model is shown in [Fig. 4].

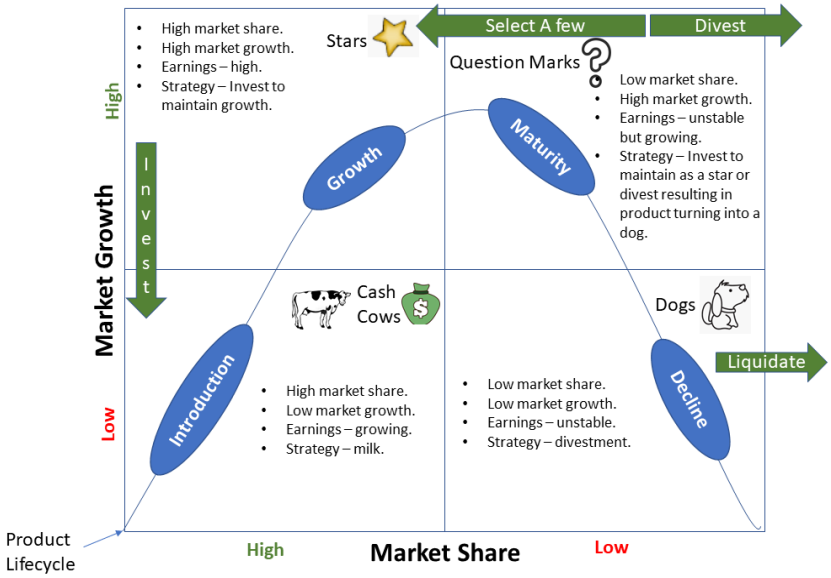

Fig 4: Boston Matrix and Product Lifecycles [BCG Henderson Institute, 1970; Johnson and Scholes, 1988; Growth-share Matrix Wiki, 2019] [22]

Manufacturers may apply different pricing strategies dependent on the quadrant their products are placed within: (1) introduction phase, premium pricing or selling at low cost to induce market penetration may be applied, or; (2) growth phase, there are likely to be competing products entering the marketplace, hence pricing may be adjusted in line with competitors, or; (3) maturity phase, price reductions to maintain market share, or; (4) decline phase reduce pricing or exit from the marketplace.

3.6 Market Behavioral Characteristics

(Porter, 1980) [31] developed the five forces model to describe market behavioral characteristics. The five forces model describes: (1) competitive rivalry – reflects the rivalry within a marketplace; (2) threat of new entrants – reflects the ability of alternative products to enter the marketplace; (3) supplier power – reflects the power of suppliers in a marketplace, expected to be high when fewer alterative products exist; (4) threat of new entrants – reflects barriers to entry to enable access to the marketplace; (5) buyer power – reflects the power of suppliers in a marketplace, expected to be high when lots of alternative products available within a marketplace. Extending the five forces to review the impacts of the reuse and circular economy model presents the view as shown in [Fig. 5].

The CE model proposes the use of open-loop manufacturing systems, where the fundamental aim is to keep on using

3.7 Traditional Product Cost and Pricing Models

Traditional product cost and pricing models fall under: (1) direct materials and direct labour; (2) direct materials, direct labour, indirect labour; (4) direct and variable costs (Porter, 1980; Cooper and Kaplan, 1988; Drury, 2017) [31, 5, 6].

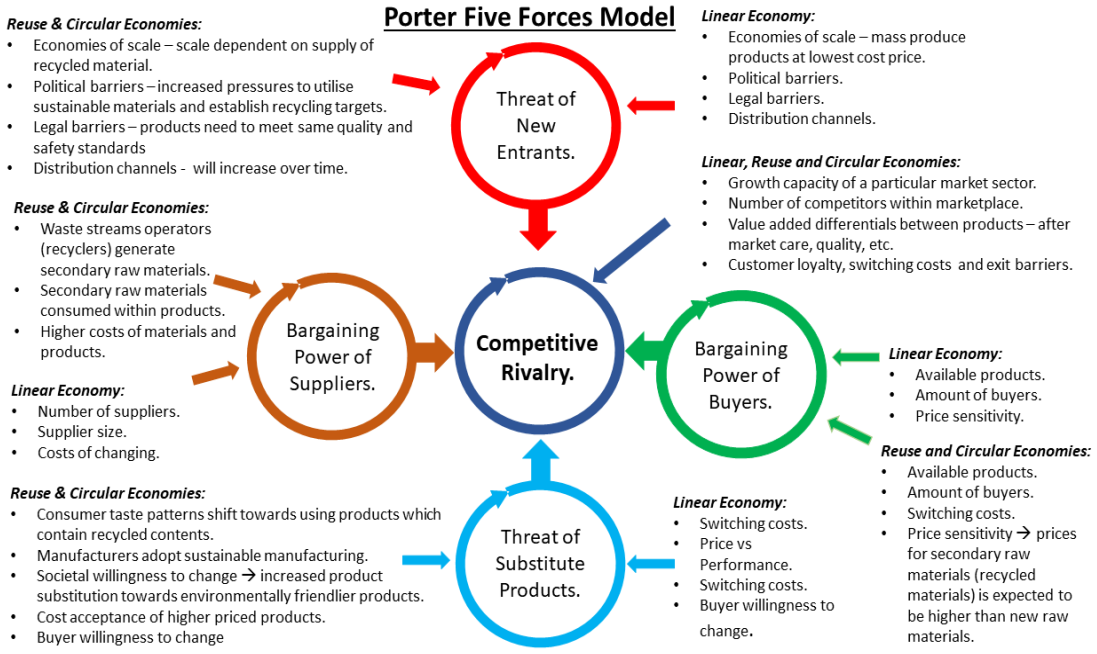

Fig 5: Porters Five Forces model applied to the Linear, Reuse and Circular Economies [Adapted from: Porter, 1980] [31].

4. Discussion

The impacts of the linear, reuse and circular economies on product and pricing models are analyzed, [Fig. 6] presents the high-level summary. The key findings are:

1. Business organizations exist to make economic gains through the sale of products and/or services.
2. Traditional product pricing depends on: (1) the cost of raw materials; (2) direct and indirect costs; (3) labour costs; (4) the product lifecycle maturity; (5) market growth; (6) level of competition; (7) buyer power; (8) supplier power; (9) threat of new entrants, and; (10) alternative / substitute product availability.
3. As more and more natural resources are becoming scarcer, this in turn will drive up raw material and energy prices, no matter which economic model is used. This means products will rise in price over time.
4. Product cost and pricing models must adapt to the costs of switching from linear raw materials, through to the design and manufacture of products using sustainable methods and materials.
5. Enabling consumer demand to switch from linear economic products, can occur via products increasing in price. A change in consumer acceptance towards sustainable products is required.
6. Manufacturers will need to absorb the costs of the R-Imperatives into costing and pricing models when placing a product onto the marketplace.
7. Product ownership models may switch over time due to products being owned by the original manufacturers, who then rent out products to consumers, after a pre-determined period, the product is then returned to a manufacturer for repair, refurbishment or recycling activities.
8. The circular economy entails more actors becoming involved with EOL products, there are both increased costs from storing and processing products, as well as new business opportunities for those involved.
9. Moving towards the circular economy will drive new business models, enabling product manufacturers to provide product differentiation, beyond providing similar products of similar quality, competing purely on price alone (Pine and Gilmore, 1998; Tukker, 2015) [30, 39].

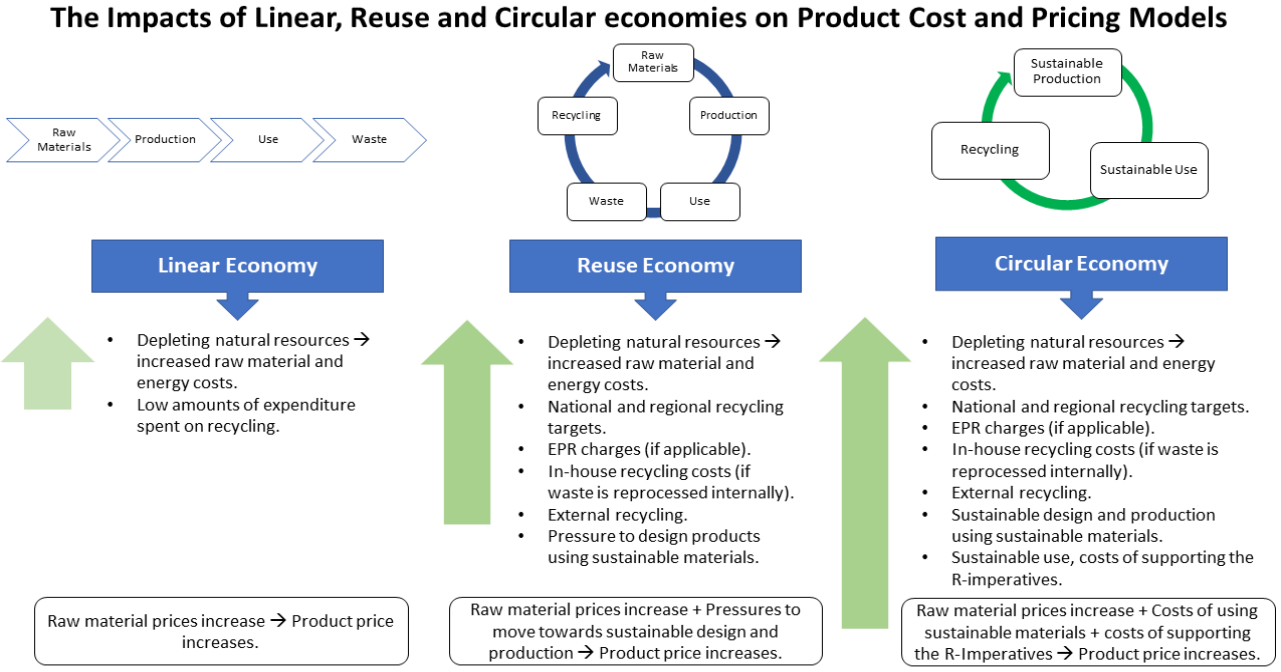

Fig 6: Impacts of the Linear, Reuse and Circular Economies on Product Cost and Pricing Models.

5. Conclusions

The purpose of this paper was to examine the implications of the linear, sustainable and circular economies on product cost and pricing models. The transition from the linear economic model to the circular economy model, is not a simple one, it will take time for product manufacturers, consumers, waste stream operators, regulators and government realize the true benefits of progressing towards the reuse and the circular economy. Moving towards the path of sustainability and the circular economy requires additional investment, resulting in increased costs and liable to increase product prices. Manufacturers need adhere to maintaining the balance, between lowering costs, to remain competitive whilst managing the costs meet regulation, recycling and renewal of products. Product pricing costs will continue to increase whether manufacturers remain in the current linear economic, sustainable or circular economic models. For industries where the use of scarce materials is maintained, as cost of scarce materials increases sharply, the progression towards sustainability and the circular economy will become a necessity. Those industries that do progress towards sustainability and the circular economy, potential new product and service offering, opportunities may occur.

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